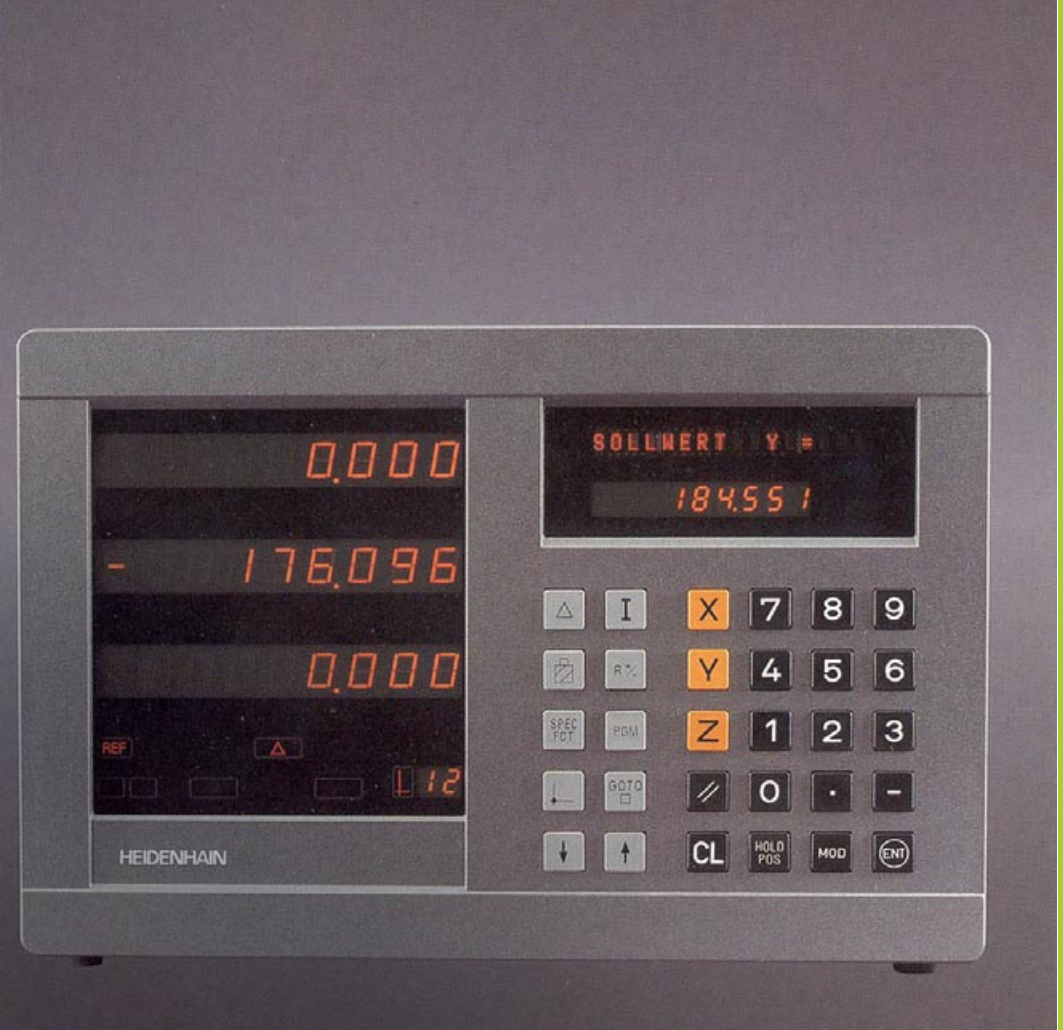


HEIDENHAIN

User´s Manual

ND 920
ND 960
NDP 960

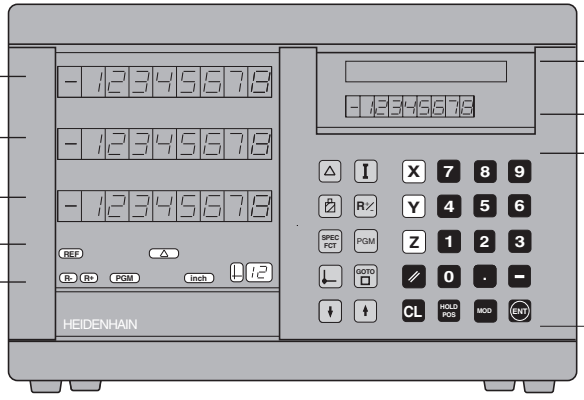
Position Display Units for Milling Machines

11/95

Position display
(ND 920: only two axes)

Message field

Input field



Status display:

Keyboard (ND 920 has no Z key)

inch	Inch display is active
△	Distance-to-go display is active
PGM	Program input is active
REF	Reference marks have been crossed
R+	Radius compensation R+ is active
R–	Radius compensation R– is active
	Datum point number

△	Distance-to-go display (traversing to zero)
I	For incremental dimensions (only with distance-to-go and program input)
	Tool compensation
R±	Call radius compensation for the current tool
SPEC FCT	Special functions (probing functions, hole patterns, rectangular pocket)
PGM	Program input
	Select datum
GOTO	Go directly to parameters or program steps
	Page in program or parameter list/ select function
X ••• Z	Select coordinate axis
0 ••• 9	Numerical input
//	Reset all axes to zero, functions for Program Input
.	Decimal point
–	Change sign or parameter
CL	Clear entry/cancel operating mode
HOLD POS	Hold current position/output measured values
MOD	Select/deselect parameter list, activate RS-232-C
ENT	Confirm entry

This manual is for ND display units with the following software numbers or higher:

ND 920 (2 axes)	**246 112 05**
ND 960 (3 axes)	**246 112 05**
NDP 960 (3 axes, panel mount)	**246 112 05**

About this manual

This manual is divided into two parts:

Part I: Operating Instructions

- Fundamentals of positioning
- ND functions

Part II: Installation and Specifications

- Mounting the display unit on the machine
- Description of operating parameters
- Switching inputs, switching outputs

Part I: Operating Instructions

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Fundamentals

You can skip this chapter if you are already familiar with coordinate systems, incremental and absolute dimensions, nominal positions, actual positions and distance-to-go.

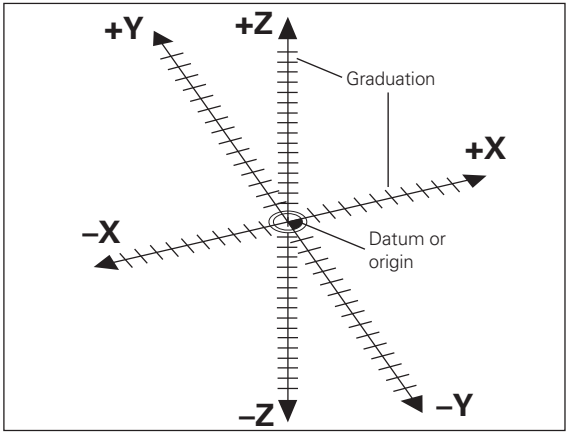
Coordinate system

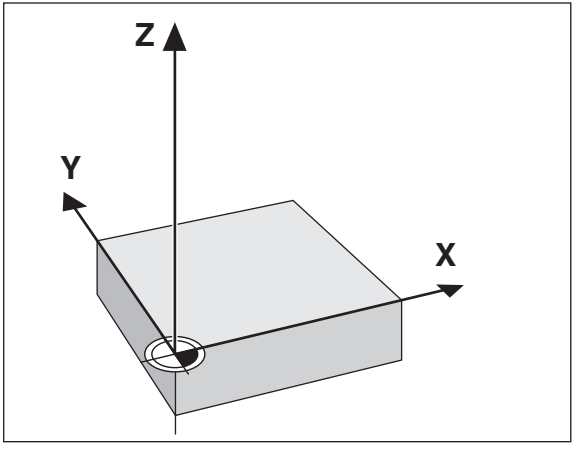
To describe the geometry of a workpiece, the *Cartesian** coordinate system is used. The Cartesian coordinate system consists of three mutually perpendicular axes X, Y and Z. The point of intersection of these axes is called the **datum** or origin of the coordinate system.

Think of the axes as scales with divisions (usually in millimeters) which allow us to fix points in space referenced to the datum.

To determine positions on a workpiece, the coordinate system is "laid" onto the workpiece.

The machine axes are parallel to the axes of the coordinate system. The Z axis is normally the tool axis.





*) Named in honor of the French mathematician and philosopher René Descartes (1596 to 1650)

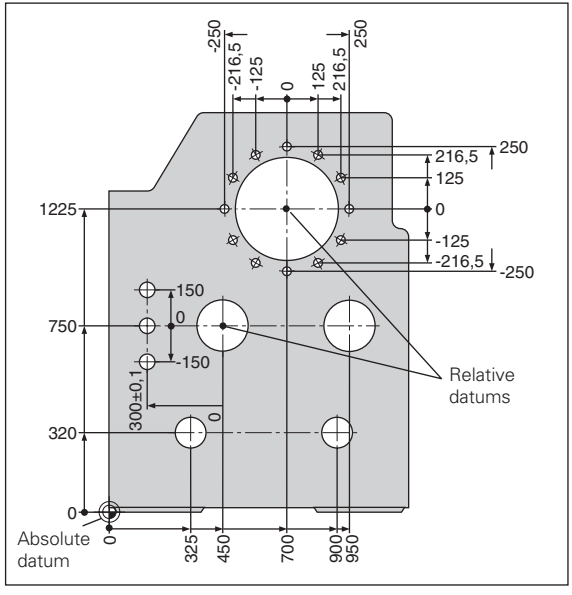
Datum setting

The workpiece drawing is used as the basis for machining the workpiece. To enable the dimensions in the drawing to be converted into traverse distances of machine axes X, Y and Z, each drawing dimension requires a datum or reference point on the workpiece (since a position can only be defined in relationship to another position).

The workpiece drawing always indicates **one** absolute datum (the datum for absolute dimensions). However, it may contain additional relative datums.

In the context of a numerical position display unit, *datum setting* means bringing the workpiece and the tool into a defined position in relation to each other and then setting the axis displays to the value which corresponds to that position. This establishes a fixed relationship between the actual positions of the axes and the displayed positions.

You can set up to 99 absolute datum points and store them in nonvolatile memory.



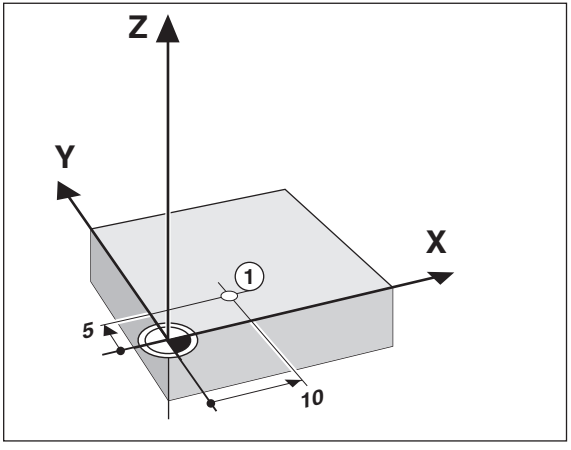
Absolute workpiece positions

Each position on the workpiece is uniquely defined by its absolute coordinates.

Example Absolute coordinates of position ①:

X = 10 mm
Y = 5 mm
Z = 0 mm

If you are working according to a workpiece drawing with absolute dimensions, you are moving the tool **to** the coordinates.



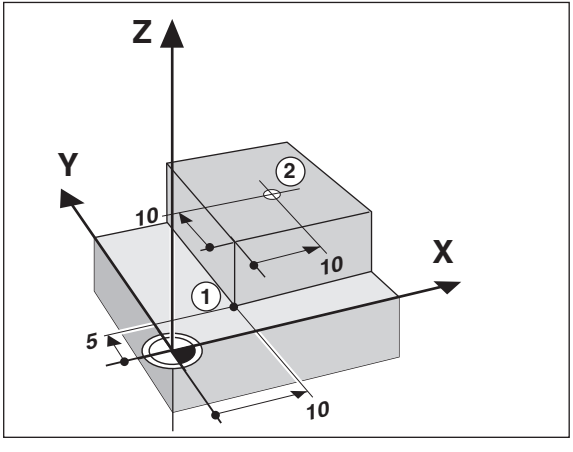
Relative workpiece positions

A position can also be defined relative to the previous nominal position. The datum for the dimension is then located at the previous nominal position. Such coordinates are termed **incremental coordinates** or chain dimensions. Incremental coordinates are indicated by a preceding **I**.

Example Relative coordinate of position ② referenced to position ① :

IX = 10 mm
IY = 10 mm

If you are working according to a workpiece drawing with incremental dimensions, you are moving the tool **by** the dimensions.



Sign for incremental dimensioning

A relative dimension has a **positive** sign when the axis is moved in the positive direction, and a **negative** sign when it is moved in the negative direction.

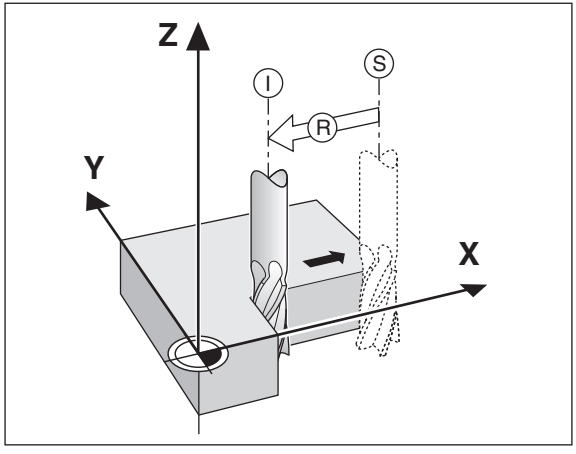
Nominal position, actual position and distance-to-go

The position to which the tool is to move is called the **nominal** position (Ⓢ). The position at which the tool is actually located at any given moment is called the **actual** position (Ⓘ).

The distance from the nominal position to the actual position is called the distance-to-go (Ⓡ).

Sign for distance-to-go

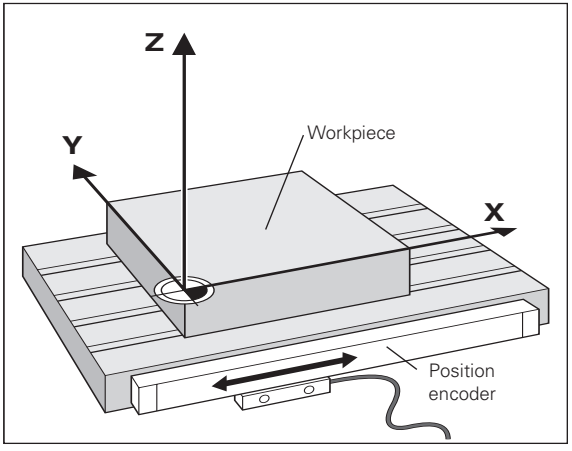
When you are using the distance-to-go display, the nominal position becomes the relative datum (display value 0). The distance-to-go is therefore negative when you move in the positive axis direction, and positive when you move in the negative axis direction.



Position encoders

The position encoders on the machine convert the movements of the machine axes into electrical signals. The ND display unit evaluates these signals, determines the actual position of the machine axes and displays the position as a numerical value.

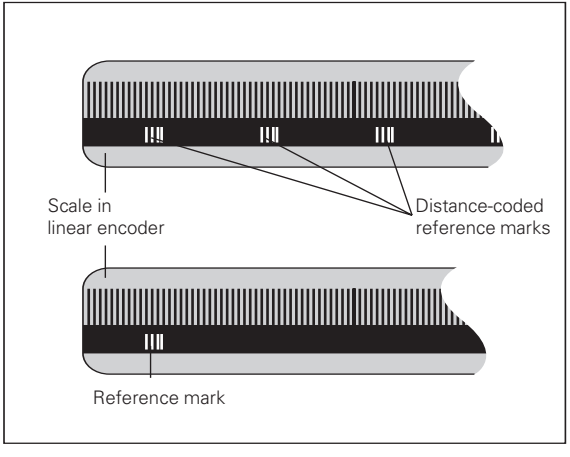
If the power is interrupted, the relationship between the machine axis positions and the calculated actual positions is lost. The reference marks on the position encoders and the REF reference mark evaluation feature enable the ND to quickly re-establish this relationship again when the power is restored.



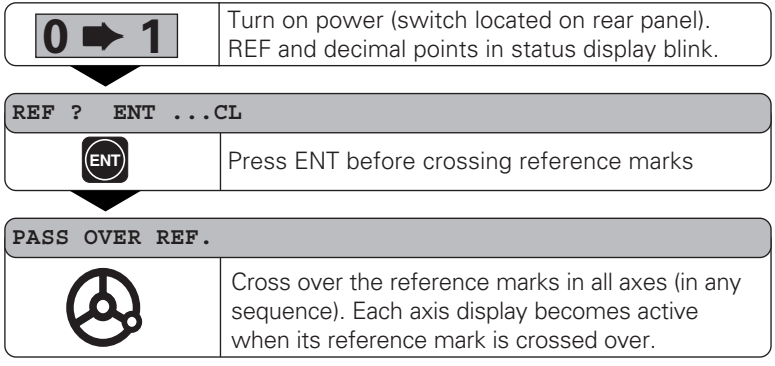
Reference marks

The scales of the position encoders contain one or more reference marks. When a reference mark is crossed over, a signal is generated which identifies that position as a reference point (scale datum = machine datum).

When this reference mark is crossed over, the ND's reference mark evaluation feature (REF) restores the relationship between axis slide positions and display values which you last defined by setting the datum. If the linear encoders have **distance-coded** reference marks, you only need to move the machine axes a maximum of 20 mm to do this.



Switch-On, Crossing Over the Reference Marks


0 ➡ 1
Turn on power (switch located on rear panel).
REF and decimal points in status display blink.
REF ? ENT ...CL
ENT
Press ENT before crossing reference marks
PASS OVER REF.
Cross over the reference marks in all axes (in any sequence). Each axis display becomes active when its reference mark is crossed over.

Crossing over the reference marks stores the last relationship between axis slide positions and display values for all datum points (99 per axis) in nonvolatile memory.

Note that if you choose *not* to cross over the reference marks (by clearing the dialog `REF ?` with the CL key), this relationship will be lost if the power is interrupted or when the unit is switched off.

Switching Between Operating Modes

You can switch between the operating modes Distance-To-Go, Special Functions, Program Input, Set Tool Datum, Hold Position and Parameter Input at any time simply by pressing another operating mode key.

Datum Setting

If you want to save the datum points in nonvolatile memory, you must first cross over the reference marks.

Only after crossing over the reference marks can you set new datums or activate existing ones.

There are several ways to set datums:

Touch the workpiece with the tool and then set the desired datum (see example). You can also touch two edges and set the centerline between them as a datum, or touch four points on a circle and set the circle center as the datum. The tool data of the tool used for this are automatically considered (see "Tool Compensation").

Probe the workpiece with the edge finder and then set the desired datum. You can also probe two edges and set the centerline between them as a datum (see examples), or probe four points on a circle and set the circle center as the datum. The display unit will automatically consider the stylus radius and length if their values are entered in parameters P25 and P26 (see "Operating Parameters").

After you have set a datum it can be activated as follows:

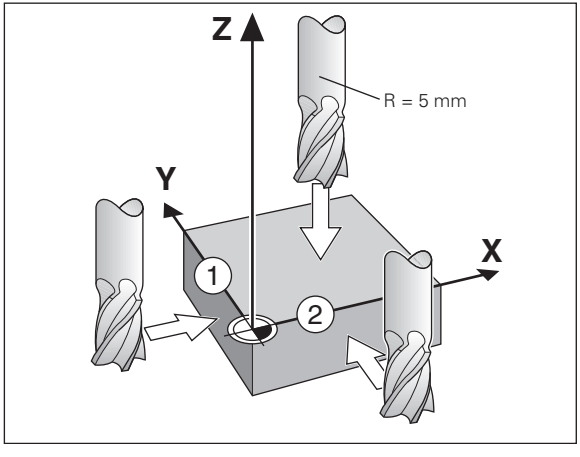
	Select datum setting.

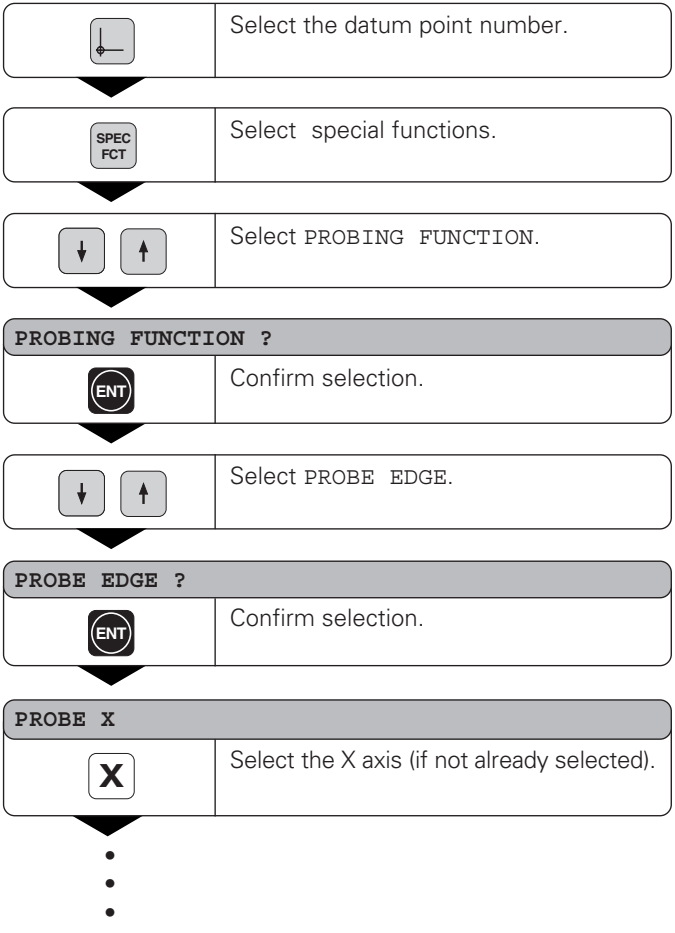
DATUM NUMBER =	
1 2 ENT	Enter the number of the datum point, for example 12.

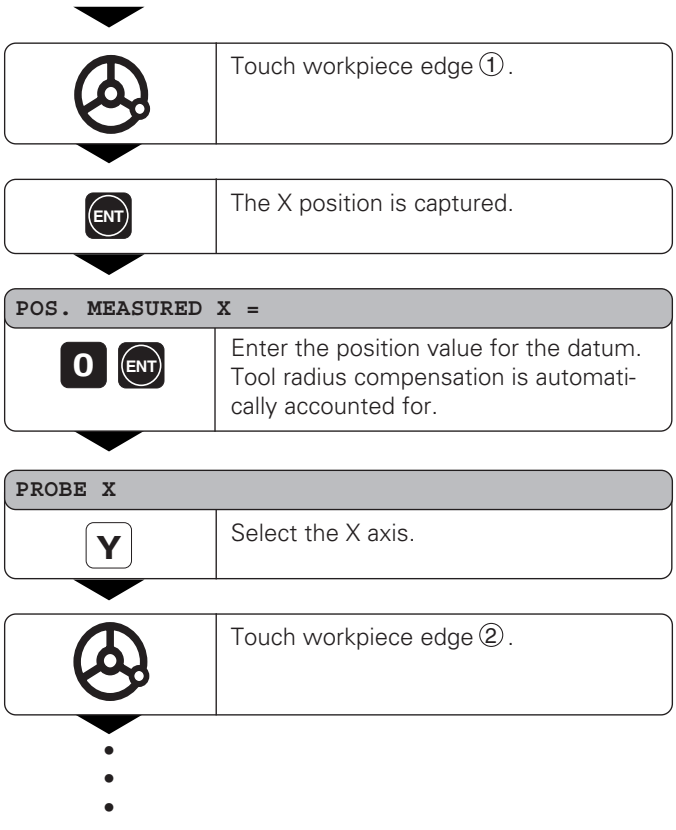
Datum setting with the tool

Example

Working plane	X / Y
Tool axis	Z
Tool radius	R = 5 mm
Axis sequence for datum setting	X – Y – Z




Select the datum point number.
SPEC FCT
Select special functions.
Select PROBING FUNCTION.
PROBING FUNCTION ?
ENT
Confirm selection.
Select PROBE EDGE.
PROBE EDGE ?
ENT
Confirm selection.
PROBE X
X
Select the X axis (if not already selected).


Touch workpiece edge ①.
ENT
The X position is captured.
POS. MEASURED X =
0
ENT
Enter the position value for the datum. Tool radius compensation is automatically accounted for.
PROBE X
Y
Select the X axis.
Touch workpiece edge ②.

ENT	The Y position is captured.

POS. MEASURED Y =

0 ENT	Enter the position value for the datum in the Y axis. Tool radius compensation is automatically considered.

PROBE Y

Z	Select the Z axis.
	Touch the workpiece with the tool.
ENT	The Z position is captured.

POS. MEASURED Z =

0 ENT	Enter the position value for the datum in the Z axis.
SPEC FCT	When you have set the datum, leave the probing function.

Datum setting with the KT edge finder

Your display unit offers the following probing functions:

PROBE EDGE	Set workpiece edge as datum
PROBE MIDPOINT	Set centerline between two workpiece edges as datum
PROBE CIRCLE	Set a circle center as datum

The probing functions can be accessed in operating mode SPEC FCT.

The HEIDENHAIN KT 120 edge finder only functions with electrically conductive workpieces.

Before you can use the edge finder you must enter the stylus diameter in parameter P25 and the stylus length in P26 (see "Operating Parameters").

The stylus dimensions you enter are considered during all probing operations.

PROBE EDGE and PROBE MIDPOINT are described on the following pages.

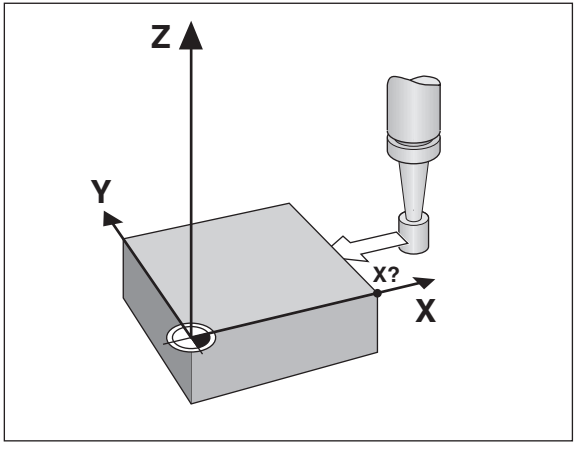
The sequence for PROBE CIRCLE is similar; however, you must probe four points before the circle center can be calculated. The circle center can then be set as the new datum.

Probing a workpiece edge and setting it as a datum

The probed edge is parallel to the Y axis. For all coordinates of a datum you can probe workpiece edges and surfaces as described below and set them as datums.

	Select the datum number.
SPEC FCT	Select special functions.
↓ ↑	Select `PROBING FUNCTION`.
`PROBING FUNCTION ?`	
ENT	Confirm selection.
↓ ↑	Select `PROBE EDGE`.
`PROBE EDGE ?`	
ENT	Confirm selection `PROBE EDGE`.

•
•



PROBE X	
X	Select the X axis (if not already selected).

PROBE X	
	Move the edge finder towards the workpiece edge until the LED in the edge finder lights up. The position of the edge is now displayed.

POS.MEASURED X =	
	Retract the edge finder from the workpiece.

POS.MEASURED X =	
5 2 ENT	Set the position value (for example 52) to this edge.

SPEC FCT	Leave the probing functions, or select a new axis.

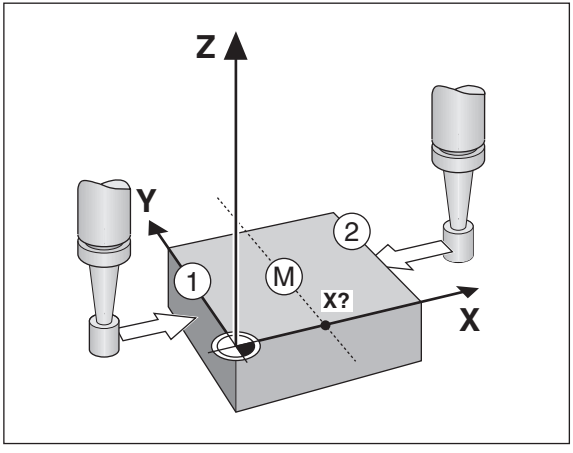
Probing workpiece edges and setting the centerline as a datum

The probed edges should be parallel to the Y axis.

You can follow these instructions for any centerlines.

	Select the datum number.
SPEC FCT	Select special functions.
↓ ↑	Select `PROBING FUNCTION`.
`PROBING FUNCTION ?`	
ENT	Confirm selection.
↓ ↑	Select `PROBE MIDPOINT`.
`PROBE MIDPOINT ?`	
ENT	Confirm selection.

•
•



1. PROBE POS. X	
X	Select X axis (if not already selected).

1. PROBE POS. X	
	Move the edge finder against workpiece edge ① until the LED in the edge finder lights up. The position of the edge is now displayed.

2. PROBE POS. X	
	Move the edge finder against workpiece edge ② until the LED in the edge finder lights up. The position of the edge is now displayed.

POS.MEASURED X =	
2 6 ENT	Enter the position value for the centerline (for example 26).

SPEC FCT	Leave the probing functions, or select a new axis.

Resetting all axes to zero

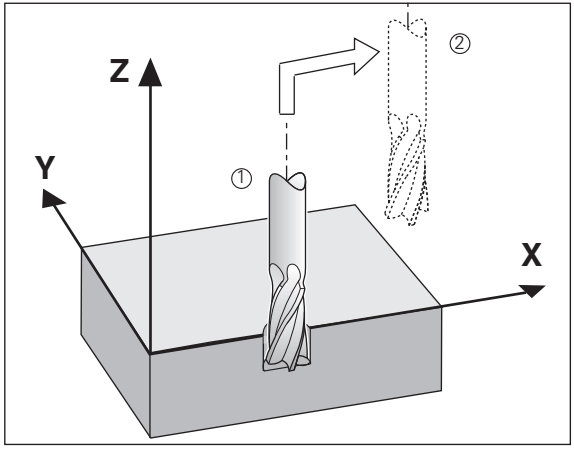
To reset all axes to zero, simply press the key shown below. Note that when you do this, the last actual position becomes the relative datum and is not stored (incremental positioning). The status display then shows "– –" instead of the datum number. Any datum points already set remain in memory. You can activate these by entering the corresponding datum point number.

	This key resets all axis position displays to zero.

Holding Positions

Your display unit has the capability to hold or "freeze" position values. The tool can be repositioned without affecting the display. You can then assign a new value to the stored position.

Example
Drill in the Z axis, measure the depth and set the datum to this depth.



	Move to the desired position and drill in Z direction ①.
HOLD POS	Hold the position.[1)]
KEEP Z POS. ?	
Z ENT	Store (hold) the position of the Z axis.

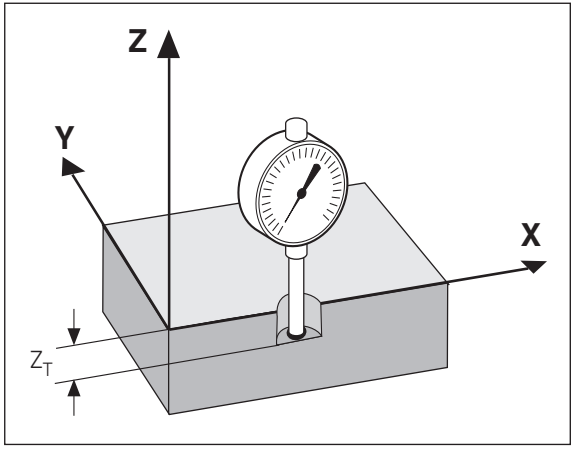
•
•
•

[1)] The HOLD POS key may have a different function. See the section "Measured value output with the HOLD POS key".

	Retract tool to position ② and measure position Z_T.

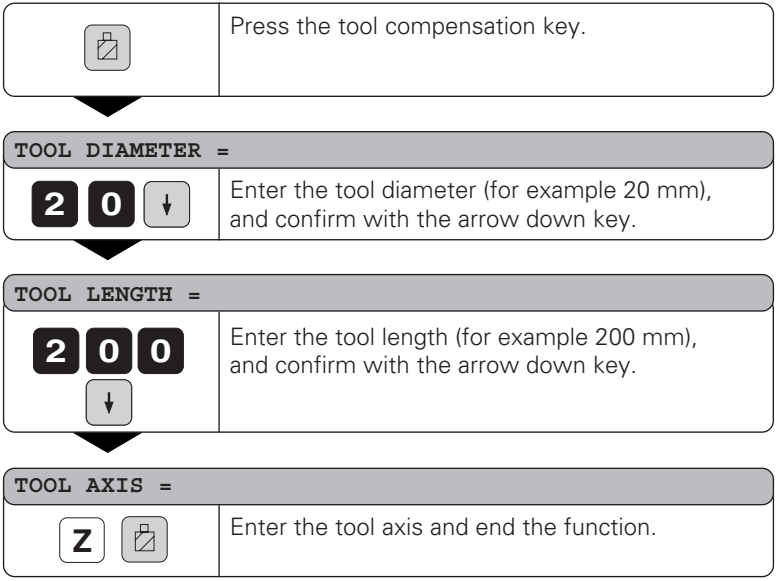
SET POS. Z =	
2 0 ENT	Set datum Z_T (for example 20).

KEEP Z POS. ?	
HOLD POS	Leave HOLD POS or store position of another axis.



Tool Compensation

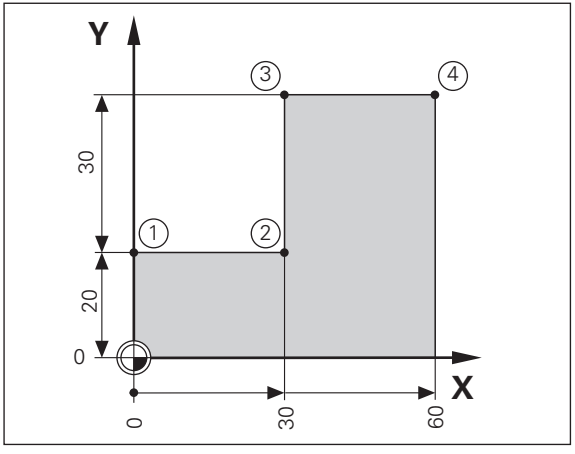
You can enter the tool axis, the tool length and the tool diameter for the current tool.


Press the tool compensation key.
TOOL DIAMETER =
2 0
Enter the tool diameter (for example 20 mm), and confirm with the arrow down key.
TOOL LENGTH =
2 0 0
Enter the tool length (for example 200 mm), and confirm with the arrow down key.
TOOL AXIS =
Z
Enter the tool axis and end the function.

Moving the Axes with the Distance-To-Go Display

Normally, the display shows the actual position of the tool. However, it is often more helpful to display the remaining distance to the nominal position (the distance-to-go). You can then position simply by moving the axis until the display value is zero.

You can enter the absolute or the relative (incremental) coordinates in the distance-to-go display. An active radius compensation will be considered.



Example: Milling a shoulder with distance-to-go

△	Select the distance-to-go function. The Δ symbol lights up.
NOML. VALUE X =	
Y 2 0 R+/- ENT	Select the axis, enter the nominal value (for example 20 mm), select radius compensation R+ and confirm with ENT.
	Move the axis until the display value is zero ①.

NOML. VALUE Y =

Select the axis, enter the nominal value (for example 30 mm), select radius compensation R– and confirm with ENT.

Move the axis until the display value is zero ②.

NOML. VALUE X =

Select the axis, enter the nominal value as an incremental dimension (for example 30 mm), select radius compensation R+ and confirm with ENT.

Move the axis until the display value is zero ③.

NOML. VALUE IY =

Select the axis, enter the nominal value (for example 60 mm), select radius compensation R+ and confirm with ENT.

•
•
•

Move the axis until the display value is zero ④.

You can then switch off the distance-to-go display.

Bolt Hole Circles and Bolt Circle Segments

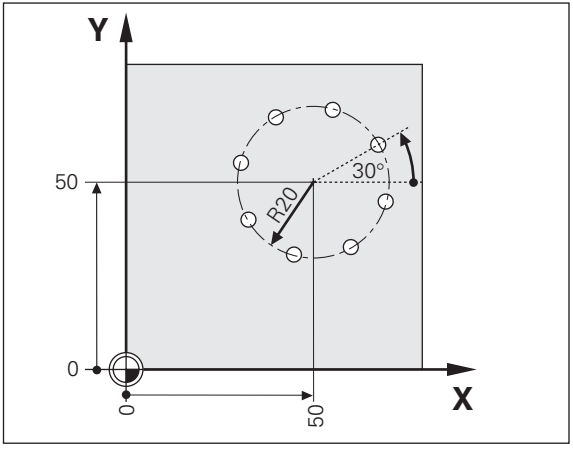
Your display unit enables you to quickly and easily drill bolt hole circles and bolt hole circle segments. The required data is requested in the message field.

Each hole can be moved to by traversing to display value zero. This requires entry of the following data:

- Number of holes (maximum: 999)
- Circle center
- Circle radius
- Starting angle for first hole
- Angle step between the holes (only for circle segments)
- Hole depth

Example

Number of holes	8
Coordinates of the center	X = 50 mm
	Y = 50 mm
Circle radius	20 mm
Starting angle	30 degrees
Hole depth	Z = -5 mm



SPEC FCT	Select special functions.
↓ ↑	Select HOLE PATTERN.

HOLE PATTERN ?

ENT	Confirm selection.
↓ ↑	Select FULL CIRCLE.

FULL CIRCLE ?

ENT	Confirm selection.

NUMBER OF HOLES=

8 ↓	Enter the number of holes (e.g. 8) and confirm with the arrow down key.

•
•
•

CIRCLE CENTR X =

X 5 0 ↓	Enter the X coordinate of the circle center (for example 50 mm) and confirm with the arrow down key.

CIRCLE CENTR Y =

Y 5 0 ↓	Enter the Y coordinate of the circle center (for example 50 mm) and confirm with the arrow down key.

RADIUS =

2 0 ↓	Enter the radius of the circle, (for example 20 mm) and confirm with the arrow down key.

START ANGLE =

3 0 ↓	Enter the starting angle for the first hole (for example 30 mm) and confirm with the arrow down key.

•
•
•

HOLE DEPTH =

Enter the hole depth (e.g. -5 mm) and confirm with the arrow down key.

START ?

Start display of the hole positions.

FULL CIRCLE
SEP :

The distance-to-go mode is now active (Δ lights up). Move to the individual hole positions by traversing to display value zero. Holes can be selected with the arrow keys or with the GOTO key.

Linear Hole Patterns

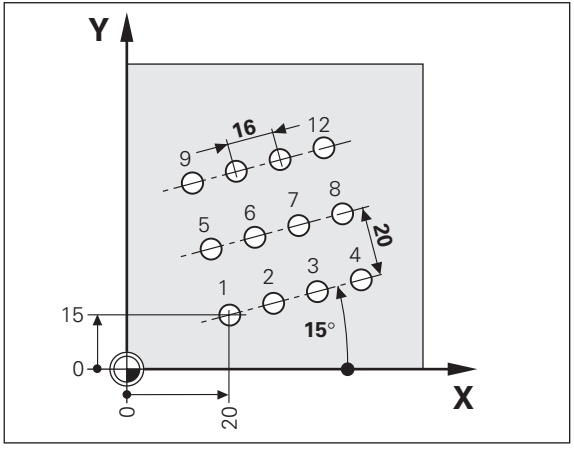
The linear hole pattern feature allows you to easily create rows of holes to cover an area. The required data are requested in the message field.

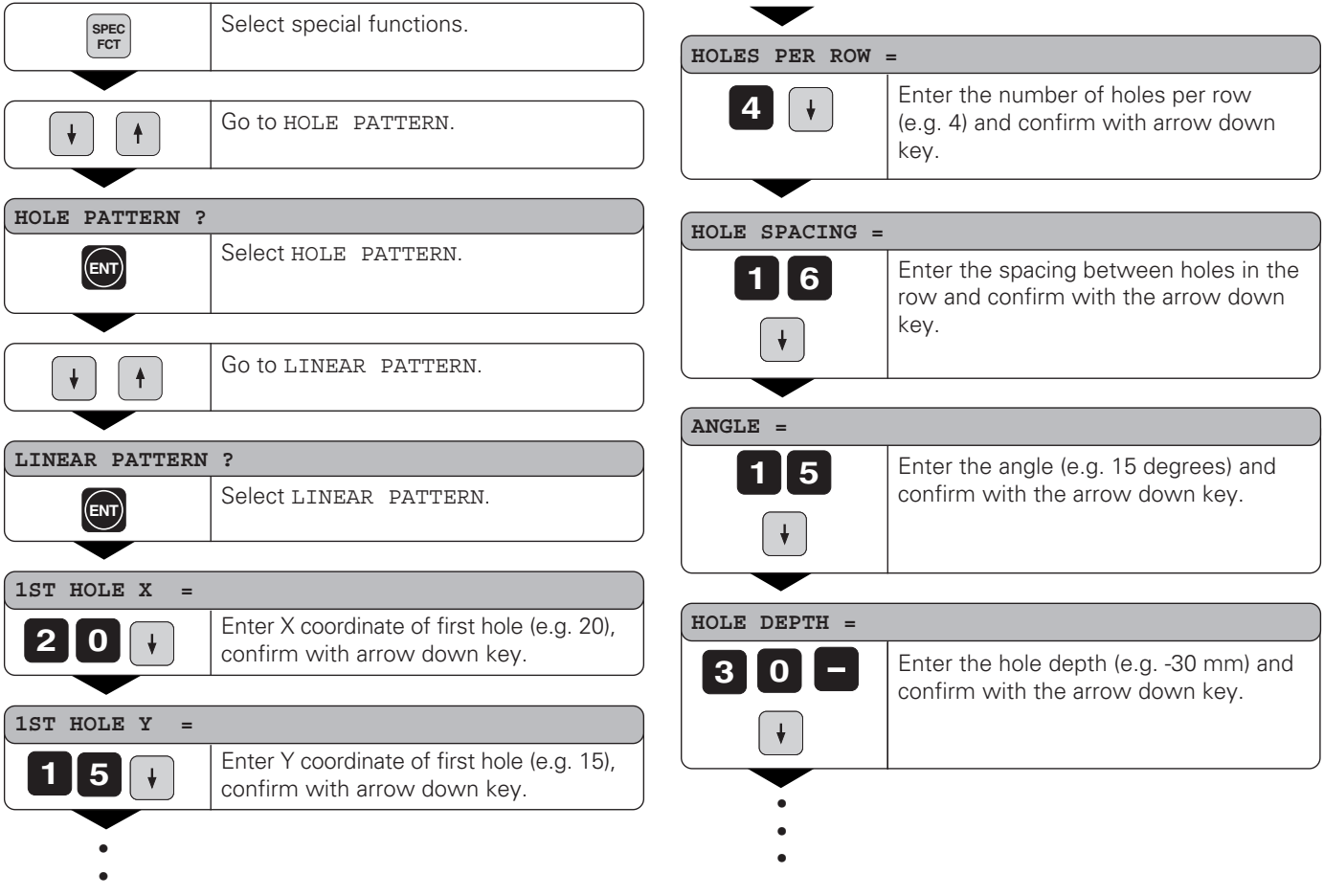
You can position to each hole by traversing to display value zero.
The following data are required:

- Coordinates of the first hole
- Number of holes per row (maximum: 999)
- Spacing between holes
- Angle between the rows and the reference axis
- Hole depth
- Number of rows (maximum: 999)
- Spacing between rows

Example

Coordinates of the first hole	X = 20 mm
	Y = 15 mm
Number of holes per row	4
Spacing between holes	16 mm
Angle	15 degrees
Hole depth	Z = -30 mm
Number of rows	3
Spacing between rows	20 mm




SPEC FCT
Select special functions.
Go to HOLE PATTERN.
HOLE PATTERN ?
ENT
Select HOLE PATTERN.
Go to LINEAR PATTERN.
LINEAR PATTERN ?
ENT
Select LINEAR PATTERN.
1ST HOLE X =
2 0
Enter X coordinate of first hole (e.g. 20), confirm with arrow down key.
1ST HOLE Y =
1 5
Enter Y coordinate of first hole (e.g. 15), confirm with arrow down key.
HOLES PER ROW =
4
Enter the number of holes per row (e.g. 4) and confirm with arrow down key.
HOLE SPACING =
1 6
Enter the spacing between holes in the row and confirm with the arrow down key.
ANGLE =
1 5
Enter the angle (e.g. 15 degrees) and confirm with the arrow down key.
HOLE DEPTH =
3 0 –
Enter the hole depth (e.g. -30 mm) and confirm with the arrow down key.

NUMBER OF ROWS =

3 ↓	Enter the number of rows (e.g. 3) and confirm with the arrow down key.

ROW SPACING =

2 0 ↓	Enter the spacing between rows (e.g. 20) and confirm with the arrow down key.

START ? =

ENT	Start display of the hole positions.

LINEAR PATTERN
StEP :

↓ ↑ GOTO □	Distance-to-go mode is now active (Δ symbol is on). Move to the individual holes by traversing to display value zero. The holes can be selected with the arrow keys or with the GOTO key.

Rectangular Pocket

Your ND display unit facilitates milling rectangular pockets. The required data are requested in the message field.

Machining begins in the center of the pocket. Using the distance-to-go display, the pocket is machined outwards in a spiral pattern until the final dimension is reached. The last step is finishing.

The infeed depends on the tool radius and is calculated automatically.

There are two conditions under which machining cannot be started: tool diameter = 0, or tool diameter ≥ side length – 2 × finishing allowance. These conditions will generate the error message TOOL ERROR.

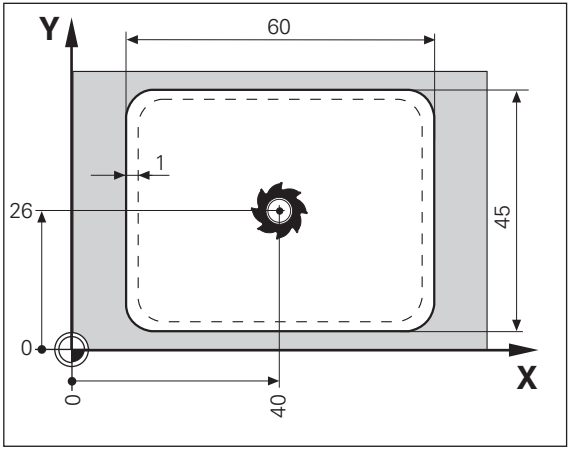
You move to each position by traversing to display value zero.

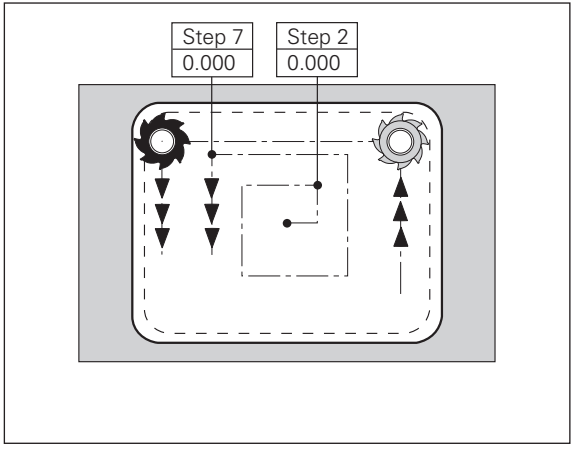
The following data must be entered to completely describe a rectangular pocket:

- The two side lengths
- Depth of the pocket
- Coordinates of the starting position (pocket center)
- Finishing allowance
- Milling direction (climb/up-cut)

Example

Dimensions of the pocket	X =	60 mm
	Y =	45 mm
Depth	Z =	-15 mm
Center point coordinates	X =	40 mm
	Y =	26 mm
Starting position	Z =	2 mm
Finishing allowance		1 mm
Milling direction		climb





SPEC FCT	Select special functions.
↓ ↑	Go to RECTANGULAR POCKET.

RECTANG.POCKET ?

ENT	Select RECTANGULAR POCKET.

SIDE LENGTH X =

6 0 ↓	Enter side length in X direction (e.g. 60), confirm with arrow down key.

SIDE LENGTH Y =

4 5 ↓	Enter side length in Y direction (e.g. 45), confirm with arrow down key.

DEPTH Z =

1 5 – ↓	Enter the pocket depth (e.g. -15), confirm with arrow down key.

•
•
•

POCKET CENTER X =

4 0 ↓	Enter X coordinate of pocket center (e.g. 40) and confirm with arrow down key.

POCKET CENTER Y =

2 6 ↓	Enter Y coordinate of pocket center (e.g. 26) and confirm with arrow down key.

STARTING POS. Z =

2 ↓	Enter starting position for tool axis (e.g. 2) and confirm with arrow down key.

ALLOWANCE =

1 ↓	Enter finishing allowance for last machining step (e.g. 1 mm) and confirm with arrow down key.

•
•
•

DOWN-CUT	
− ↓	Use the minus key to select down-cut milling (climb milling) or up-cut milling, and confirm with the arrow down key.

START ?	
ENT	Start rectangular pocket milling.

RECTANG.POCKET StEP 0	
CL	Distance-to-go mode is now active (Δ symbol is on). You move to the individual clear-out positions by traversing to display value zero. When you reach a position, the display automatically shows the next step until machining is completed. When you have cleared out the pocket at one level, the display returns to block 0 so you can clear out the next level. To interrupt machining, press CL. This returns the display to the dialog START ?.

Scaling Factors

Scaling factors enable you to increase or decrease the display values based on the actual traverse distance. The display values are changed symmetrically about the datum.

Enter scaling factors separately for each axis in parameter P12.

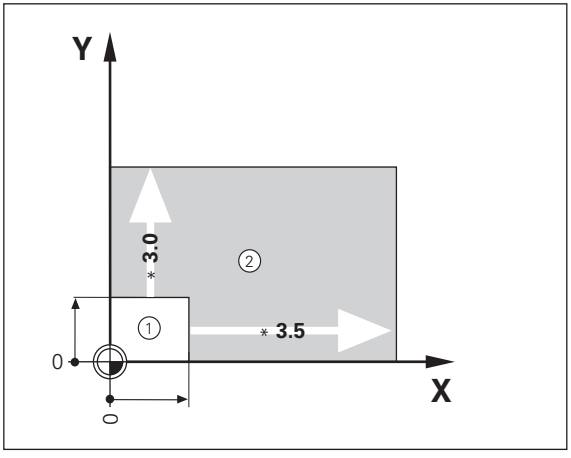
Parameter P11 activates and deactivates the scaling factors in all axes (see "Operating Parameters").

Example for increasing a workpiece:

P12.1	3.5
P12.2	3.0
P11	ON

This results in a larger workpiece as shown in the illustration at right:

① is the original size, ② is with axis-specific scaling factors.



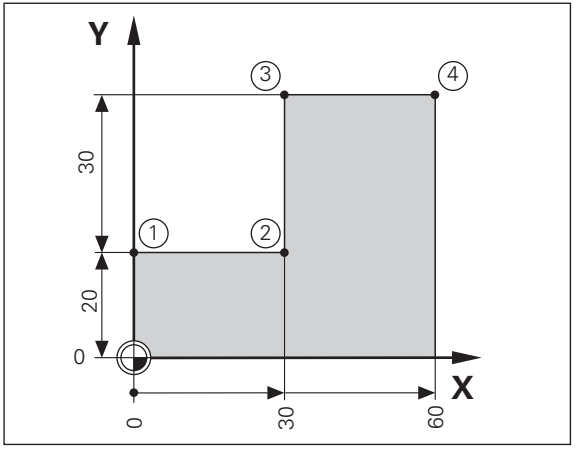
The only way to tell whether a scaling factor is active is by looking at the setting of parameter P11.

Program Input

For small-lot production you can enter the sequence of positioning steps in the operating mode Program Input (PGM key). Up to 99 positioning steps are possible. The program remains in memory even when the power is turned off or otherwise interrupted.

The display unit goes into the distance-to-go mode when Program Input is activated. You can move to the entered positions simply by traversing to display value zero. The program blocks can be entered in absolute or incremental dimensions. The Δ symbol in the status display continues blinking until the block is completely entered.

You can start from any positioning block in a finished program.



Example: Milling a step

Tool data:	Radius	6 mm
	Length	50 mm
	Axis	Z
Starting position:	X	-6 mm
	Y	0 mm
	Z	0 mm

PGM	Select program input.

```
AXIS ?
StEP   :
```

Y 2 0 R+/- ENT	Select the axis, enter the nominal value in absolute dimensions (for example 20 mm), enter radius compensation R+ and confirm with ENT if you wish to position immediately.
↓	Select the next block.

```
AXIS ?
StEP   2
```

X 3 0 R+/- ENT	Select the axis, enter the nominal value in absolute dimensions (for example 30 mm), enter radius compensation R– and confirm with ENT if you wish to position immediately.

Enter further blocks in the same manner.

Finished program:

1	Y	+20	R+
2	X	+30	R–
3	IY	+30	R+
4	X	+60	R+

Delete program, delete block, insert empty block

Program Input is active.

	Select functions for deleting/inserting.

	With the arrow keys, select the desired function (for example, `DELETE BLOCK`).

`DELETE BLOCK ?`	
	Start the selected function.

Program Output over RS-232-C Interface

Programs in memory can be output over the RS-232-C/V.24 interface (see following sequence). Programs can also be downloaded.

PGM	Select program input.
MOD	Select RS-232-C/V.24 functions.
↓ ↑	Select program output to FE 401 floppy disk unit.
PGM OUTPUT FE ?	
ENT	Confirm program output to FE 401 floppy disk unit.
PGM NUMBER ?	
4 5 ENT	Key in the program number.
OUTPUT ACTIVE	
CL	You can interrupt data transfer with the CL key.

Programs can be transferred to the FE 401 floppy disk unit, a PC or a printer.

The RS-232-C/V.24 setting for a printer is stored under EXT (standard data interface). The RS-232-C/V.24 setting for the FE 401 or a PC is stored under FE. A question in the message field asks which interface you wish to activate.

To transfer a program stored in your ND you must assign the program a number. To load this program again, you must call it with the same program number.

A special software package is available from HEIDENHAIN for data transfer to a PC. This software must be installed on the PC.

Parameter P50 specifies the baud rate (see "Operating Parameters").

For additional information, see the chapter "RS-232-C/V.24 Interface."

Error Messages

Message	Problem
CALL IS TOO FAST	Two commands for measured value output occurred too close together.
AMPL. X TOO LOW	The encoder signal is too weak. The scale may be contaminated.
PROBING ERROR	The axis must move at least 6 µm before probing.
DSR SIG. MISSING	The attached device is not sending a DSR signal.
INPUT ERROR	The entered value is not within the permissible input range.
ERROR: REF. X	The spacing of the reference marks as defined in P43 is not the same as the actual spacing.
FORMAT ERROR	Data format, baud rate, etc., do not agree.
FRQ. EXCEEDED X	The input frequency for this encoder input is too high. This can occur when the scale is moved too fast.
COMP. DELETED	Compensation values for non-linear axis error compensation erased.

Message	Problem
OFFSET DELETED	Offset compensation values for encoder signals erased.
PARAM. ERASED	Check the operating parameters. If this error recurs, contact your service agency.
PGM ERASED	The program has been deleted. If this error recurs, contact your service agency.
PGM TOO LARGE	The maximum program length is 99 blocks.
PRESET ERASED	The datum points have been erased. If this error recurs, contact your service agency.
KEY W/O FUNCTION	This key currently has no function.
TEMP. EXCEEDED	The temperature of the ND is too high.

To clear error messages

When you have removed the cause of the error,

➤ press the CL key.

Part II: Installation and Specifications

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Items Delivered

- **ND 920** for two axes
  or
- **ND 960** for three axes
  or
- **NDP 960** for three axes

- **Power connector**
  Id.-Nr. 257 811 01

- **User's Manual**

Optional Accessories

- **Tilting base**
  Id.-Nr. 281 619 01

- **KT 120 Edge Finder**
  Id.-Nr. 276 416 01

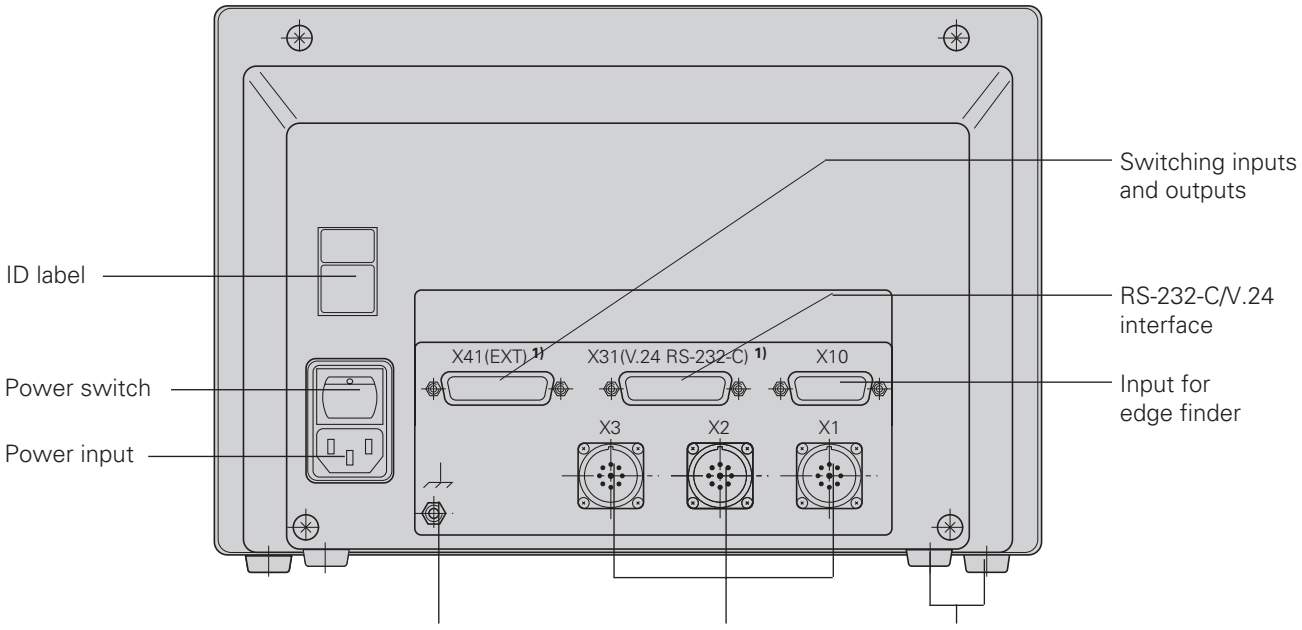
- **KT 130 Edge Finder**
  Id.-Nr. 283 273 01

- **Connector** (female), 25-pin, for D-sub connection X41
  Id.-Nr. 249 154 ZY

- **Data interface cable**, 25-pin, length 3 m
  Id.-Nr. 274 545 01

- **Connector** (male), 25-pin, for D-sub connection X31
  Id.-Nr. 245 739 ZY

Connections on Rear Panel



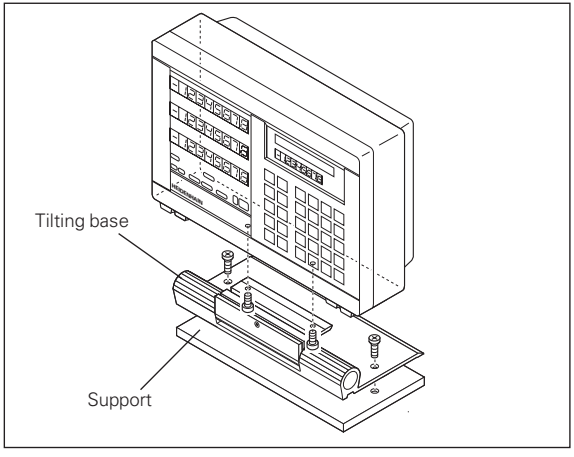
1) Option with ND 920/ND 960

Connections X1, X2, X3, X31 and X41 are not shock hazardous according to EN 50178.

Mounting

ND 920/ND 960
To mount the display unit on a support, use the M4 threaded holes in the rubber feet. You can also mount the display unit on the optional tilting base.

NDP 960
This unit is designed for installation in an operating panel using the supplied mounting frame (see "Dimensions").



Power Connection

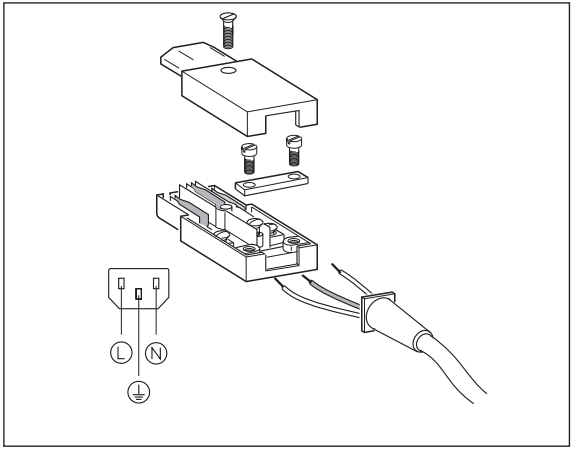
Power leads: Ⓛ and Ⓝ
Protective ground: ⏚

- **Danger of electrical shock!**
  Connect a protective ground. This connection must never be interrupted.
- Unplug the power cord before opening the housing.

To increase the noise immunity, connect the ground terminal on the rear panel to the central ground point of the machine. (Minimum cross-section: 6 mm²)

The display unit will operate over a voltage range of 100 V to 240 V AC. A voltage selector is not necessary.

Danger to internal components!
Use only original replacement fuses.
Two line fuses and a fuse for the switching outputs are inside the housing.
Fuse types: Line: F 2.5 A 250 V
Switching outputs: F 1 A



Connecting the Encoders

Your display unit will accept all HEIDENHAIN linear encoders with sinusoidal output signals (11 to 40 μA_{pp}) and distance-coded or single reference marks.

Assignment of the encoder inputs

Encoder input X1 is for the X axis
Encoder input X2 is for the Y axis
Encoder input X3 is for the Z axis (ND 960 only)

Encoder monitoring system

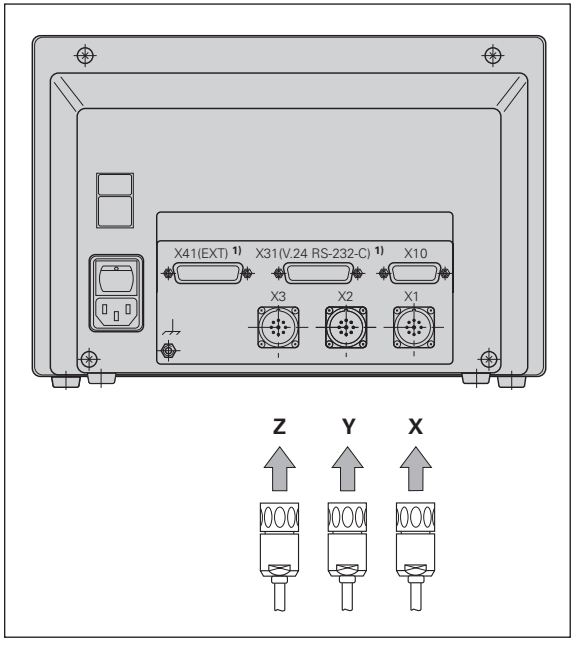
Your display unit features a monitoring system for checking the amplitude and frequency of the encoder signals. If it detects a faulty signal, one of the following error messages will be generated:

```
AMPL.X TOOL LOW
AMPL.X TOO HIGH
FRQ. EXCEEDED X
```

Encoder monitoring can be activated with parameter P45.

If you are using linear encoders with distance-coded reference marks, the encoder monitoring system also checks whether the spacing of the reference marks as defined in parameter P43 is the same as the actual spacing on the scales. If it is not, the following error message will be generated:

```
ERROR: REF. X
```



1) Option with ND 920/ND 960

Operating Parameters

Operating parameters allow you to modify the operating characteristics of your display unit and define the evaluation of the encoder signals. Operating parameters that can be changed by the user are called user parameters, and can be accessed with the MOD key and the dialog PARAMETER (user parameters are identified as such in the parameter list). The full range of parameters can only be accessed through CODE NUMBER.

Operating parameters are designated by the letter P and a number. Example: **P11**. The parameter designation is shown in the input field as you press the arrow keys to select a parameter. The parameter setting is displayed in the message field.

Some operating parameters have separate values for each axis. Such parameters have an additional index number from 1 to 3 (ND 920: 1 to 2).

Example P12.1 scaling factor, X axis
P12.2 scaling factor, Y axis
P12.3 scaling factor, Z axis (ND960/NDP960 only)

Operating parameters P60 and P61 (definition of the switching ranges) have an index from 0 to 7.

The operating parameters are preset before the unit leaves the factory. These factory settings are indicated in the parameter list in **boldface type**.

Entering and changing operating parameters

To access the operating parameters

➤ Press the MOD key
➤ Confirm with ENT to access the user parameters, or select the dialog for entering the code number **(95148)** with the arrow down key to be able to change all operating parameters.

To page through the operating parameters

➤ Page forwards by pressing the arrow down key.
➤ Page backwards by pressing the arrow up key.
➤ Go directly to an operating parameter by pressing GOTO, keying in the parameter number and then pressing ENT.

To change parameter settings

➤ Press the minus key or enter the value and confirm with the ENT key.

To correct an entry

➤ Press CL. This restores the old value.

To leave the operating parameters

➤ Press MOD again.

P1 Unit of measurement [1]

Display in millimeters	**mm**
Display in inches	inch

P3.1 to P3.3 Radius/diameter display [1]

Display position value as radius	**RADIUS DISPLAY X**
Display position value as diameter	DIAM. DISPLAY X

P11 Activate scaling factor [1]

Scaling factor active	SCALING ON
Not active	**SCALING OFF**

P12.1 to P12.3 Enter scaling factor [1]

Enter a scaling factor separately for each axis:
Entry value > 1: workpiece will "grow"
Entry value = 1: workpiece will remain the same size
Entry value < 1: workpiece will "shrink"

Input range:	0.100000 to 9.999999
Factory setting:	**1.000000**

P23 Display of position values for measured value output [1] [2]

When a measured value is output through pulse, contact or CTRL B it is first latched (stored in a buffer) and then sent over the RS-232-C interface. Parameter P23 selects the display mode for the latching process.

Display is not stopped during the latching process	**DISPLAY: ACTUAL**
Display is stopped during the latching process	DISPLAY: HOLD
Display is stopped but is updated by each latching process	DISPLAY: STOP

P25 Probe diameter [1]

Input range (millimeters):	0.000 to 999.999
Factory setting	**6**

P26 Probe length [1]

Input range (millimeters):	**0.000** to 999.999

P30.1 to P30.3 Counting direction

Positive counting direction with positive direction of traverse	**COUNTR. X : POS.**
Negative counting direction with positive direction of traverse	COUNTR. X : NEG.

P31.1 to P31.3 Signal period of encoder

2 µm / 4 µm / 10 µm / **20 µm** / 40 µm
100 µm / 200 µm / 12800 µm

P32.1 to P32.3 Subdivision of the encoder signals

128 / 100 / 80 / 64 / 50 / 40 / **20** / 10 / 5 / 4 / 2 / 1 / 0.5 / 0.4 / 0.2 / 0.1

[1] User parameter
[2] Only on units with RS-232-C/V.24 and EXT connection

P40.1 to P40.3 Select type of axis error compensation

No axis error compensation	**AXIS COMP X OFF**
Linear error compensation active, multipoint error comp. not active	AXIS COMP X LIN
Multipoint error compensation active, linear error compensation not active	AXIS COMP X F(a)

P41.1 to P41.3 Linear axis error compensation

Input range (µm): –99999 to +99999
Factory setting: **0**

Example Displayed length L_d = 620.000 mm
Actual length (as determined for example with the VM 101 from HEIDENHAIN)
L_a = 619.876 mm
Difference DL = L_a – L_d = –124 µm
Compensation factor k:
k = DL/L_d = –124 µm/0.62 m = **–200** [µm/m]

P43.1 to P43.3 Reference marks

One reference mark	0
Distance-coded with 500 x SP	500
Distance-coded with 1000 x SP	**1000**
Distance-coded with 2000 x SP	2000
Distance-coded with 5000 x SP	5000

(SP = signal period)

P44.1 to P44.3 Reference mark evaluation

Reference mark evaluation active	**REF. MODE X ON**
Not active	REF. MODE X OFF

P45.1 to P45.3 Encoder monitoring

Amplitude and frequency monitoring active	**ALARM X ON**
Not active	ALARM X OFF

P48.1 to P48.3 Activate axis display

Axis display active	**AXIS DISPL.X ON**
Not active	AXIS DISPL.X OFF

P49.1 to P49.3 Axis designation, measured value output [2]

For output of the measured value, an axis designation can be defined with the number of the ASCII character. The axis designation is output together with the measured value.

Input range:	0 to 127	
Measured value output disabled	0	
ASCII character from ASCII table	1 to 127	
Factory setting:	P49.1	**88**
	P49.2	**89**
	P49.3	**90**

P50 Baud rate [1] [2]

110 / 150 / 300 / 600 / 1200 / 2400 / 4800 / **9600** / 19 200 / 38 400

P51 Blank lines for measured value output [1] [2]

Input range: 0 to 99
Factory setting **1**

[1] User parameter
[2] Only on units with RS-232-C/V.24 and EXT connection

P60.0 to P60.7 Activate switching range for EXT connection and assign to the axes [2]

No switching range	**SWITCH OUT.0 OFF**
Switching range for X axis	SWITCH OUT.0 X
Switching range for Y axis	SWITCH OUT.0 Y
Switching range for Z axis	SWITCH OUT.0 Z

P61.0 to P61.7 Define switching range for EXT connection [2]

Enter switching point (= display value): the switching range is symmetrical about the display value 0.
Input range (in millimeters): **0** to 99 999.999

P81.1 to P81.3 Encoder

Max. encoder signal 16 μA_{pp}	**ENCODER X 16µA**
Max. encoder signal 40 μA_{pp}	ENCODER X 40µA

P96 Measured value output with probing [2]

Measured value output active	PROBE RS232 ON
Not active	**PROBE RS232 OFF**

P97 Code for measured values [2]

ASCII character for identifying measured values for measured value output with probing, contact or pulse

Input range:	**0** to 127
No ASCII character	0
ASCII character from ASCII table	1 to 127

P98 Dialog language [1]

German	**DIALOG LANG. D**
English	DIALOG LANG. GB
French	DIALOG LANG. F
Italian	DIALOG LANG. I
Dutch	DIALOG LANG. NL
Spanish	DIALOG LANG. E
Danish	DIALOG LANG. DK
Swedish	DIALOG LANG. S
Czech	DIALOG LANG. CZ
Japanese	DIALOG LANG. J

[1] User parameter
[2] Only on units with RS-232-C/V.24 and EXT connection

Linear Encoders

Setting the display step with linear encoders

The display step depends on the

- **signal period** of the encoder **(P31)** and the
- **subdivision (P32).**

Both parameters are entered separately for each axis.

For linear measurement using nut/ballscrew arrangements and rotary encoders, calculate the signal period as follows:

$$\text{Signal period [µm]} = \frac{\text{Drivescrew pitch [mm] x 1000}}{\text{Line count}}$$

Display step, signal period and subdivision for linear encoders

Display step		P31: Signal period [µm]							
		2	4	10	20	40	100	200	12 800
[mm]	[inches]	P32: Subdivision							
0.000 02	0.000 001	100	–	–	–	–	–	–	–
0.000 05	0.000 002	40	80	–	–	–	–	–	–
0.000 1	0.000 005	20	40	100	–	–	–	–	–
0.000 2	0.000 01	10	20	50	100	–	–	–	–
0.000 5	0.000 02	4	8	20	40	80	–	–	–
0.001	0.000 05	2	4	10	20	40	100	–	–
0.002	0.000 1	1	2	5	10	20	50	100	–
0.005	0.000 2	0.4	0.8	2	4	8	20	40	–
0.01	0.000 5	0.2	0.4	1	2	4	10	20	–
0.02	0.001	–	–	0.5	1	2	5	10	–
0.05	0.002	–	–	0.2	0.4	0.8	2	4	–
0.1	0.005	–	–	0.1	0.2	0.4	1	2	128
0.2	0.01	–	–	–	–	–	–	–	64

Compatible HEIDENHAIN linear encoders

Encoder	Signal period P31	Ref. marks P43	Display step mm	Display step inches	Sub-division P32
LIP 40x	**2**	**0**	0.001 0.000 5 0.000 2 0.000 1 0.000 05 0.000 02	0.000 05 0.000 02 0.000 01 0.000 005 0.000 002 0.000 001	**2** **4** **10** **20** **40** **100**
LIP 101A LIP 101R	**4**	**0**	0.001 0.000 5 0.000 2 0.000 1 0.000 05	0.000 05 0.000 02 0.000 01 0.000 005 0.000 002	**4** **8** **20** **40** **80**
LIF 101R LIF 101C LF 401 LF 401C	**4**	**0** **5000** **0** **5000**	0.001 0.000 5 0.000 2 0.000 1	0.000 05 0.000 02 0.000 01 0.000 005	**4** **8** **20** **40**
LID xxx LID xxxC	**10**	**0** **2000**	0.001 0.000 5 0.000 2 0.000 1	0.000 05 0.000 02 0.000 01 0.000 005	**10** **20** **50** **100**
LS 103 LS 103C LS 405 LS 405C ULS/10	**10**	**0** **or** **1000**			

Encoder	Signal period P31	Ref. marks P43	Display step mm	Display step inches	Sub-division P32
LS 303 LS 303C LS 603 LS 603C	**20**	**0** **or** **1000**	0.01 0.005	0.000 5 0.000 2	**2** **4**
LS 106 LS 106C LS 406 LS 406C LS 706 LS 706C ULS/20	**20**	**0** **or** **1000**	0.01 0.005 0.002 0.001 0.000 5	0.000 5 0.000 2 0.000 1 0.000 05 0.000 02	**2** **4** **10** **20** **40**
LIDA 10x LB 302	**40**	**0** **or** **2000**	0.002 0.001 0.000 5	0.000 1 0.000 05 0.000 02	**20** **40** **80**
LIDA 2xx LB 3xx LB 3xxC	**100**	**0** **1000**	0.01 0.005 0.002 0.001	0.000 5 0.000 2 0.000 1 0.000 05	**10** **20** **50** **100**
LIM 102	**12 800**	**0**	0.1	0.005	**128**

Multipoint Axis Error Compensation

If you want to use the multipoint axis error compensation feature, you must
- activate this feature with operating parameter P40 (see "Operating Parameters")
- traverse the reference marks after switching on the display unit
- enter compensation value table

Your machine may have a non-linear axis error due to factors such as axis sag or drivescrew errors. Such deviations are usually measured with a comparator measuring system (such as the HEIDENHAIN VM 101).

For example, you can determine the screw pitch error X=F(X) for the X axis.

An axis can only be corrected in relation to **one** axis that has an error. In each axis, a compensation value table with 64 compensation values can be generated. You can select the compensation value table with the MOD key and the dialog "CODE NUMBER".

All necessary entries for multipoint error compensation are requested in dialogs.

Entries in the compensation value table

- Axis to be corrected: X, Y or Z (Z axis only with ND 960 or NDP 960)
- Axis causing the error: X, Y or Z (Z axis only with ND 960 or NDP 960)
- Datum for the axis to be corrected:
  Here you enter the point starting at which the axis with error is to be corrected. This point indicates the absolute distance to the reference point.

Do not change the datum point after measuring the axis error and before entering the axis error into the compensation table.

- Spacing of the compensation points
  The spacing of the compensation points is expressed as 2^X [µm].
  Enter the value of the exponent *x* into the compensation value table.
  Minimum input value: 6 (= 0.064 mm)
  Maximum input value: 20 (= 1048.576 mm)
  Example: 600 mm traverse and 35 compensation points: results in 17.143 mm spacing between points. Nearest power of two: 2^{14} [µm] = 16.384 mm
  Entry in compensation value table: 14
- Compensation value
  You enter the measured compensation value (in millimeters) for the displayed compensation point. Compensation point 0 always has the value 0 and cannot be changed.

To select the compensation value table and enter an axis correction

MOD	Press MOD.

PARAMETER ?

↓	Select dialog for entering the code number.

CODE NUMBER ?

1 0 5 2 9 6 ENT	Enter 105296 and confirm with ENT. The ND displays the REF values (reference point = datum).

COMP. AXIS = X

X ↓	Select the axis to be corrected (e.g. X), and confirm with the arrow down key.

X = FKT (X)

X ↓	Enter the axis causing the error (e.g. X) (screw pitch error), and confirm with the arrow down key.

•
•
•

DATUM X =

2 7 ↓	Enter the active datum for the error on the axis to be corrected (e.g. 27 mm) and confirm with the arrow down key.

POINT SPACING X=

1 0 ↓	Enter the spacing of the compensation points on the axis to be corrected, for example 2^{10} µm (equals 1024 mm) and confirm with the arrow down key.

X 27.000 X =

↓ 0 • 0 1 ↓	Select compensation point no. 1, enter the associated compensation value (e.g. 0.01 mm) and confirm with the arrow down key.

X 28.024 X =

Enter all further compensation points. If you press and hold the arrow down key when selecting the next compensation point, the number of the current compensation point will be displayed in the input line. You can go directly to compensation points by using the GOTO key and entering the corresponding number.

MOD	Conclude entry.

To delete a compensation value table

MOD	Press MOD.
PARAMETER ?	
↓	Select the dialog for entering the code number.
CODE NUMBER ?	
1 0 5 2 9 6 ENT	Enter 105296 and confirm with ENT.
COMP. AXIS = X	
Z //	Select the compensation value table (e.g., for the Z axis), and delete the table.
DEL.COMP.AXIS Z?	
ENT	Confirm with ENT, or cancel with CL.
MOD	Conclude entry.

RS-232-C/V.24 Interface

(Option with ND 920/ND 960)

The data interface on your ND display unit enables you to use a printer, a PC or the HEIDENHAIN FE 401 floppy disk unit for transferring measured values or programs.

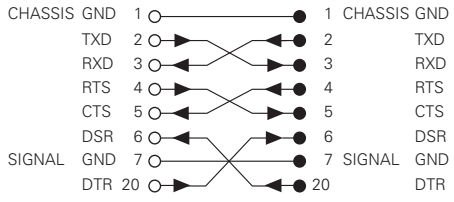
The interface is permanently set to the following data format:

1 start bit
7 data bits
Even parity bit
2 stop bits

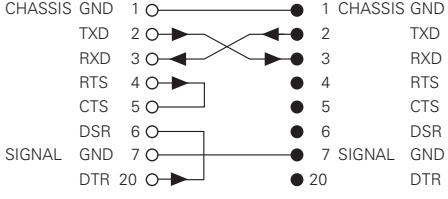
The baud rate is set with parameter P50. See "Program Output over RS-232-C/V.24 Interface" for instructions on how to start output to a printer, a PC or the FE 401.

For connection to peripheral devices you can use either full wiring (figure at upper right) or simplified wiring (below right).

Full wiring



Simplified wiring



Pin layout X31 (RS-232-C/V.24)

Pin	Signal	Assignment
1	CHASSIS GND	Chassis
2	TXD	Transmitted data
3	RXD	Received data
4	RTS	Request to send
5	CTS	Clear to send
6	DSR	Data set ready
7	SIGN. GND	Signal ground
8...19	–	Not assigned
20	DTR	Data terminal ready
21..25	–	Not assigned

Levels for TXD and RXD

Logic level	Voltage level
"1"	–3 V to –15 V
"0"	+3 V to +15 V

Levels for RTS, CTS, DSR and DTR

Logic level	Voltage level
"1"	+3 V to +15 V
"0"	–3 V to –15 V

Measured Value Output

Measured values can be output over the RS-232-C/V.24 interface. This can be done with the following functions:

Probing with the KT Edge Finder
"Contact" input on X41
"Pulse" input on X41
CTRL B over the RS-232-C interface
Measured value output with the HOLD POS key.

Parameter P23 influences the display mode for measured value output. It is not effective, however, for output from probing.

Code letters with the measured value

Parameter P97 allows you to select a code letter to be output together with the measured value when using Probe, Contact or Pulse. The decimal number you enter in the parameter is the ASCII character number in the ASCII table. If you enter 0, no code letter will be output. The code letter enables you to recognize whether the measured value was generated with CTRL B or with an external signal.

Axis designation for measured value output

Parameter P49 allows you to enter an axis designation for each measured value that is output. The decimal number you enter in the parameter is the ASCII character number in the ASCII table. If you enter 0, no axis designation will be output.

Example of measured value output:

Parameter settings:

P49.1	=	88	("X")
P49.2	=	89	("Y")
P49.3	=	90	("Z")
P51	=	0	(no blank lines)
P97	=	69	("E")

Output:

E (CR)(LF)
X=...(CR)(LF)
Y=...(CR)(LF)
Z=...(CR)(LF)

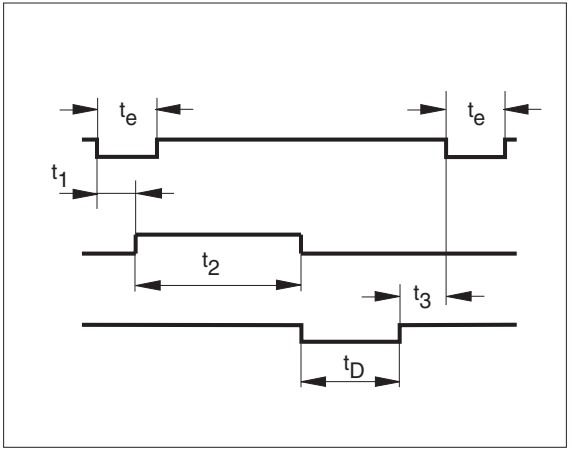
Measured value output when probing

Parameter P96 allows you to activate measured value output when probing with the KT edge finder. The edge finder is connected to D-sub input X10.

Whenever the Probe Edge function is used, your display unit outputs the position of the edge in the selected axis and the actual positions of the other axes over the TXD line of the RS-232-C/V.24 interface.

Whenever the Probe Midpoint function is used, your display unit outputs the calculated midpoint in the selected axis and the actual positions of the other axes.

Measured value output with CTRL B is inhibited when a probing function is active.



Delay times with data output

Duration of the latch signal:	$t_e \geq 4$ µs
Storage delay:	$t_1 \leq 4.5$ ms
Data output after:	$t_2 \leq 50$ ms
Regeneration time:	$t_3 \geq 0$

Duration of data output in seconds:

$$t_D = \frac{176 \text{ x number of axes } + 11 \text{ x number of blank lines}}{\text{Baud rate}}$$

Next possible signal for measured value output:
$t_E = t_1 + t_2 + t_D + t_3$ [s]

Example of measured value output when probing

Example: Probe Edge, X axis

P	R	X	:	+	5854	.	2504		R	<CR>	<LF>
Y			:	–	1012	.	8660		R	<CR>	<LF>
Z			:	+	8590	.	3042	?	R	<CR>	<LF>

Example: Probe Midpoint, X axis

C	L	X	:	+	3476	.	2504		R	<CR>	<LF>
Y			:	–	1012	.	8660		R	<CR>	<LF>
Z			:	+	8590	.	3042		R	<CR>	<LF>
①			②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Probed axis <PR>, <CL> / other axes
② Colon
③ Plus or minus sign
④ 2 to 7 places before the decimal
⑤ Decimal point
⑥ 1 to 6 places after the decimal
⑦ Unit: blank = mm, " = inches, ? = error message
⑧ R = radius display, D = diameter display
⑨ Carriage Return
⑩ Line Feed

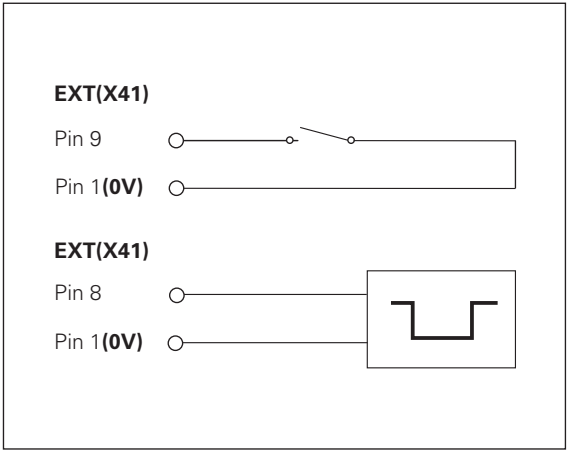
Measured value output over the Contact and Pulse inputs

Measured value output over the Contact input (pin 9 on X41) and Pulse input (pin 8 on X41) can be triggered when these inputs are closed against 0 V.

The measured values are output over the TXD line of the RS-232-C interface.

A commercially available switch can be attached to the Contact input. This switch generates a signal for data output when it makes contact against 0 V.

The Pulse input can be triggered with TTL logic devices (for example, SN74LSXX).



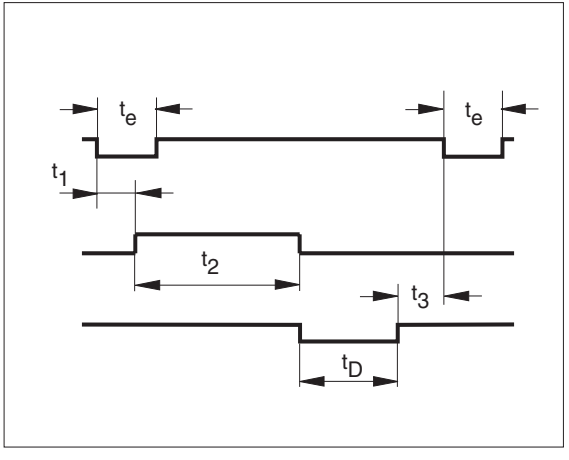
Delay times for data output

Latch signal duration: Pulse	$t_e \geq 1.2\ \mu s$
Latch signal duration: Contact	$t_e \geq 7\ ms$
Storage delay: Pulse	$t_1 \leq 0.8\ \mu s$
Storage delay: Contact	$t_1 \leq 4.5\ ms$
Data output after	$t_2 \leq 30\ ms$
Regeneration time	$t_3 \geq 0$

Duration of data output in seconds:

$$t_D = \frac{176 \times \text{number of axes} + 11 \times \text{number of blank lines}}{\text{Baud rate}}$$

Next possible signal for measured value output:
$t_E = t_1 + t_2 + t_D + t_3$ [s]



Measured value output with CTRL B

If the control character STX (CTRL B) is received over the RS-232-C interface, the measured value referenced to this time point will be sent over the interface. CTRL B is received over RXD and the measured values are output over TXD.

BASIC program for measured value output:

```
10      L%=48
20      CLS
30      PRINT "V.24/RS232"
40      OPEN "COM1:9600,E,7" AS#1
50      PRINT #1, CHR$ (2);
60      IF INKEY$<>""THEN 130
70      C%=LOC(1)
80      IF C%<L%THEN 60
90      X$=INPUT$(L%,#1)
100     LOCATE 9,1
110     PRINT X$;
120     GOTO 50
130     END
```

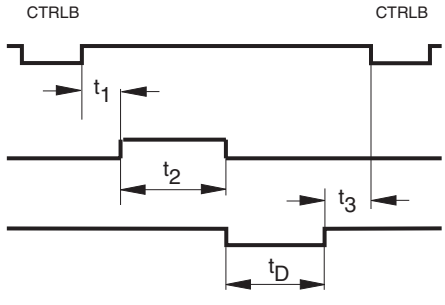
Delay times for data output

Storage delay	$t_1 \leq$ 0.5 ms
Data output after	$t_2 \leq$ 30 ms
Regeneration time	$t_3 \geq$ 0 ms

Duration of data output in seconds:

$$t_D = \frac{176 \times \text{number of axes} + 11 \times \text{number of blank lines}}{\text{Baud rate}}$$

Next possible signal for measured value output:
$t_E = t_1 + t_2 + t_D + t_3$ [s]



Measured value output with the HOLD POS key

The function of the HOLD POS key can be changed by entering a code number. Enter the code number 246 522.

Press the "–" key to select the dialog HOLD POS or PRT.
Press ENT to save the selected function in non-volatile storage.

If you selected PRT, the position values will be output through the RS-232-C/V.24 interface whenever you press HOLD POS.

Example of measured value output with Contact input, Pulse input, CTRL B, or the HOLD POS key

E	<CR>	<LF>							
X	=	+	5854	.	2504		R	<CR>	<LF>
Y	=	-	1012	.	8660		R	<CR>	<LF>
Z	=	+	8590	.	3042		R	<CR>	<LF>
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Axis designation
② Equality sign
③ Plus or minus sign
④ 2 to 7 places before the decimal
⑤ Decimal point
⑥ 1 to 6 places after the decimal
⑦ Unit: blank = mm, " = inches, ? = error message
⑧ R(r) = radius display, D(d) = diameter display, ( ) = distance-to-go display
⑨ Carriage Return
⑩ Line Feed

Switching Inputs and Outputs X41 (EXT)

(Option with ND 920/ND 960)

Pin layout

	Pin	Function
Outputs	10	0V for switching ranges
	23, 24, 25	+24 Vdc for switching ranges
	11	ND ready for operation
	14	Display value outside switching range 0
	15	Display value outside switching range 1
	16	Display value outside switching range 2
	17	Display value outside switching range 3
	18	Display value outside switching range 4
	19	Display value outside switching range 5
	20	Display value outside switching range 6
	21	Display value outside switching range 7
Inputs	1	0 V (internal)
	2	Reset X axis display to zero
	3	Reset Y axis display to zero
	4	Reset Z axis display to zero (ND960 only)
	8	Pulse: output measured value
	9	Contact: output measured value
	5, 6, 7, 12, 13, 22	Do not assign

Signal level	Low		High
Inputs Pins 2, 3, 4	–0.5 V ≤ U ≤ 0.9 V	I ≤ 6 mA	3.9 V ≤ U ≤ 15 V

The outputs at connection X41 are metalically isolated from the device electronics by means of optocouplers.

- **Danger for internal components!**
  Voltage sources for external circuitry must conform to the recommendations in EN 50178 for low-voltage electrical separation.
- Connect inductive loads only with a quenching diode parallel to the inductance.

- **Use only shielded cable!**
  Connect the shield to the connector housing.
- Interface X41 complies with the recommendations in EN 50178 for separation from line power.

Switching ranges

Up to eight switching ranges can be defined with operating parameters. You can assign the switching ranges to the axes as desired with parameters P60 and P61. The switching ranges are symmetrical to the display value 0.

The switching signals are present on the D-sub connection X41 on pins 14 to 21.

Pins 23 to 25 must be connected to 24 Vdc (U_s). Outside the switching ranges the 24 Vdc circuit to the switching outputs at pins 14 to 21 is closed; within the switching ranges it is open.

Permissible loading of the outputs

High signal: $U_{amin} = U_s - 1.6$ V
$I_{amax} = 100$ mA

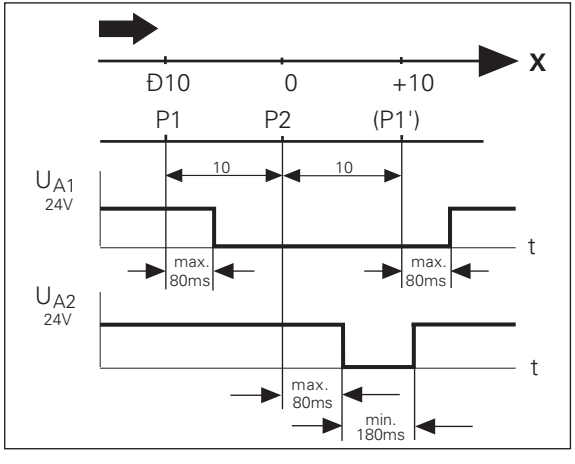
Inductive loads must be driven with a quenching diode parallel to the inductance.

DC supply voltage

U_s = +24 Vdc
U_{smin} = +20.4 Vdc
U_{smax} = +31.0 Vdc

Voltage spikes up to 36 V for t < 100 ms are permissible.

The diagram at right shows the voltage curves U_{A1} and U_{A2} of outputs A1 and A2 when approaching zero from the negative direction and when the switching points P1 and P2 are assigned to the X axis.

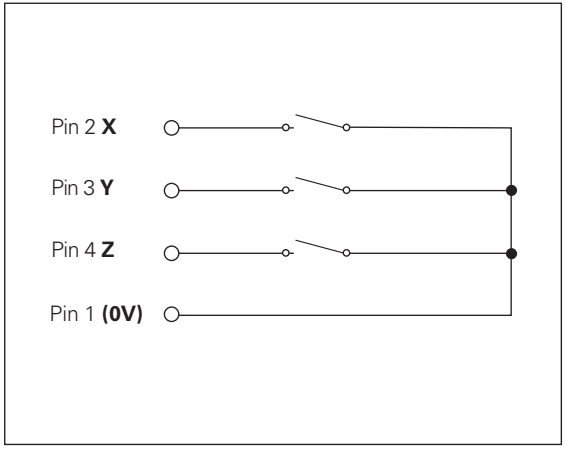


Resetting the display to zero with an external signal

Each axis can be reset to zero with an external signal at the D-sub connection X41 (pins 2 to 4) by means of make contact against 0 V. Make contact against 0 V must be present for at least 100 ms.

A zero reset does not affect the current datum number.

Zero reset is not possible when a probing function is active.



Pin Layout X10 for Edge Finder

Pin	Function		
1	Internal shield		
2	Standby		(KT 130)
6	U_P	+5 V	(KT 130)
8	U_P	0 V	(KT 130)
13	Switching signal		(KT 130)
14	Contact	+2.5 V	(KT 120)
15	Contact	0 V	(KT 120)
3, 4, 5, 7, 9, 10, 11, 12,	Do not assign		
Housing	External shield		

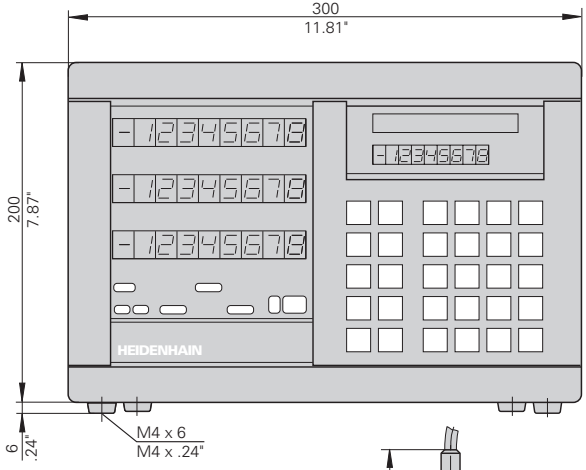
Specifications

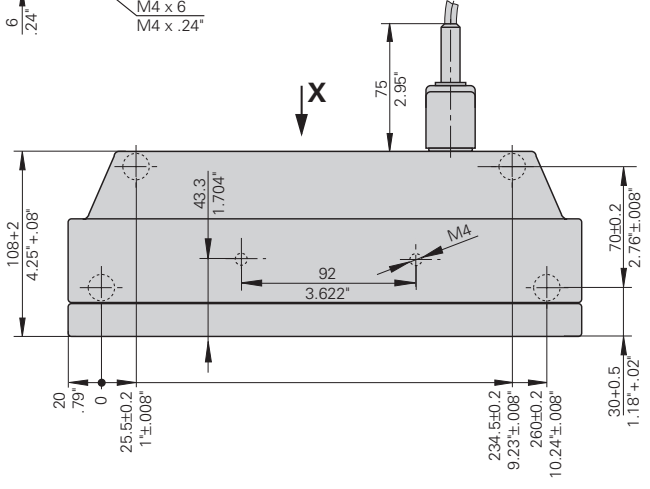
Housing	**ND 920 / ND 960** Bench-top design, cast-metal housing 300 x 200 x 108 mm (W x H x D) **NDP 960** For panel mounting using supplied mounting frame, cast-metal housing 350 x 250 x 108 mm (W x H x D)
Operating temp.	0° to 45°C (32° to 113°F)
Storage temp.	–30° to 70°C (–22° to 158°F)
Weight	3 kg (approx.)
Relative humidity	< 75% annual average < 90% in rare cases
Power supply	100 V to 240 V (–15% to +10%) 48 Hz to 62 Hz
Power consumption	ND 960 / NDP 960: 19 W ND 920: 17 W
Protection	IP 40 (IEC 529)

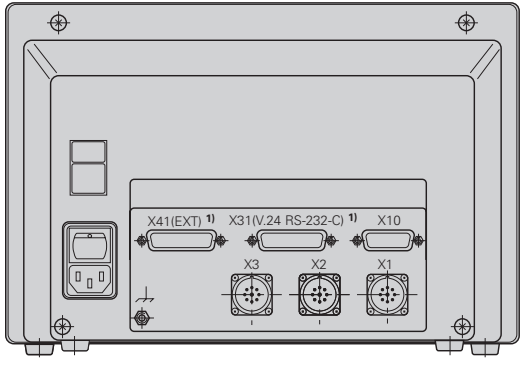
Encoder inputs	For encoders with 7 to 16 μA_{pp} or 16 to 40 μA_{pp} output signals Grating period: 2, 4, 10, 20, 40, 100, 200 µm, and 12.8 mm Reference mark evaluation for distance-coded and single reference marks
Input frequency	Max. 100 kHz with 30 m cable
Display step	Adjustable (see "Linear Encoders")
Datum points	99 (nonvolatile)
Functions	– Tool radius compensation – Distance-to-go display – Program memory for 99 positioning steps – Probing functions – Circular & linear hole patterns – Rectangular pocket – Scaling factor – Eight switching ranges [1] – Zero reset with external signal [1] – Measured value output [1]
RS-232-C/V.24 Interface [1]	Baud rates: 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19 200, 38 400

[1] Option with ND 920/ND 960

ND 920/ND 960: Dimensions in mm/inches

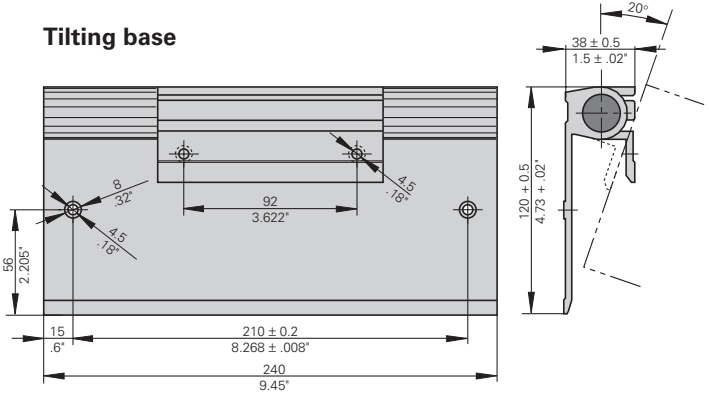




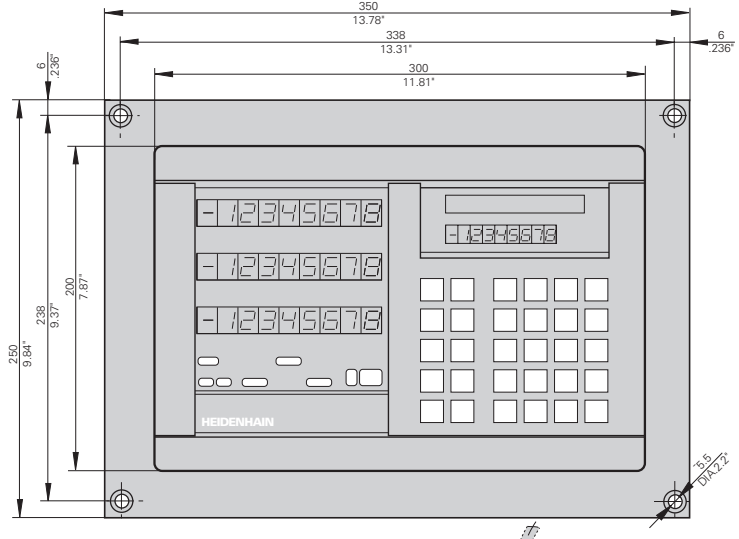


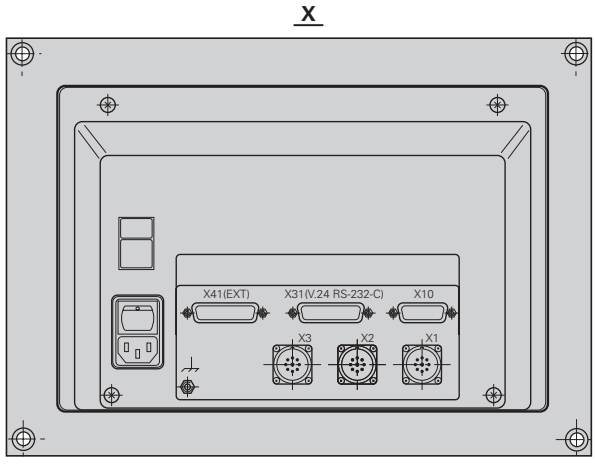
1) Option with ND 920/ND 960

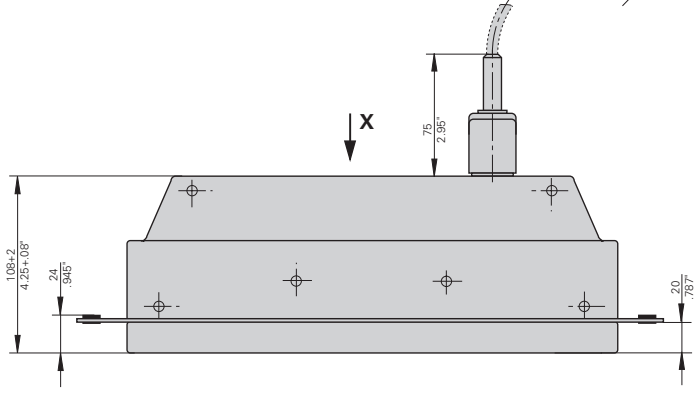
Tilting base



NDP 960: Dimensions in mm/inches







front panel opening 322 ± 1 mm x 222 ± 1 mm
12.68 ± .04 in. x 8.74 ± .04 in.

HEIDENHAIN

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